

WHAT IS CLAIMED IS:

1. An electric drill apparatus having a low profile, comprising:  
an annular cutter for cutting at a high rotational speed, and having a  
plurality of cutting blades comprised of cemented carbide tips fixed on its lower  
end;

a motor for rotating at a high speed suitable for a cutting operation  
of the annular cutter with the cemented carbide tips;

a rotary shaft assembly for rotating the annular cutter attached to its  
leading end about a rotating shaft which rotates in a direction different from that of  
a rotating shaft of the motor;

a rotation reduction mechanism disposed between the motor and  
rotary shaft assembly for transmitting a driving force of the motor to the annular  
cutter through the rotary shaft assembly;

a feed mechanism responsive to an operation of a manual handle,  
for moving the rotary shaft assembly along with a straight line to advance or  
retract the annular cutter attached to the rotary shaft assembly with respect to a  
workpiece; and

an adhesion base disposed below a body of the electric drill  
apparatus for securing the electric drill apparatus to the workpiece.

2. An electric drill apparatus according to Claim 1 further comprising  
an automatic motor stopping/re-driving mechanism which comprises:

a main switching element connected in series between the motor  
and a power supply;

a current detector for detecting a load current flowing through the  
motor;

a determination unit for determining whether the load current  
detected by the current detector exceeds a first predetermined reference value; and

a control unit for controlling the main switching element to turn  
on/off, wherein when the determination unit determines that the load current

exceeds the first reference value, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the determination unit determines that the load current decreases to be smaller than the first reference value, the control unit turns on the main switching element at a predetermined time after the determination, to supply the current from the power supply to the motor.

3. An electric drill apparatus according to Claim 1, wherein the adhesion base comprises a magnetic base having a magnet.

4. An electric drill apparatus according to Claim 1, wherein the rotating shaft of the rotary shaft assembly is substantially perpendicular to the rotating shaft of the motor.

5. An electric drill apparatus, comprising:  
a motor for rotating an annular cutter;  
a main switching element connected in series between the motor  
and a power supply;  
a current detector for detecting a load current flowing through the motor;  
a determination unit for determining whether the load current detected by the current detector exceeds a first predetermined reference value; and  
a control unit for controlling the main switching element to turn on/off, wherein when the determination unit determines that the load current exceeds the first reference value, the control unit turns off the main switching element to shut off the current flowing through the motor, and subsequently when the determination unit determines that the load current decreases to be smaller than the first reference value, the control unit turns on the main switching element at a predetermined time after the determination, to supply the current from the power supply to the motor.

6. An electric drill apparatus according to Claim 5, further comprising:

a rotary shaft assembly for rotating the annular cutter attached to its leading end about a rotating shaft which rotates in a direction different from that of a rotating shaft of the motor.

5           7.       An electric drill apparatus according to Claim 6, wherein the rotating shaft of the rotary shaft assembly is substantially perpendicular to the rotating shaft of the motor.

10           8.       An electric drill apparatus according to Claim 5, wherein the annular cutter comprises cutting blades comprised of cemented carbide chips fixed on its lower end and at positions opposing a plurality of swarf exhaust grooves, respectively.

            9.       An electric drill apparatus according to Claim 5, further comprising:  
a second determination unit for determining whether the load current detected by the current detector exceeds a second reference value lower than the first reference value; and

15                   a load condition indication unit for indicating a normal load condition when the second determination unit determines that the load current does not exceed the second reference value, and indicating an overload condition when the second determination unit determines that the load current exceeds the second reference value.

20           10.      An electric drill apparatus according to Claim 5, wherein the current detector is a fixed resistor connected in series with the motor and main switching element to output a voltage obtained across the resistor correspondingly to the load current, and

25                   the first determination means is adapted to receive the voltage corresponding to the load current, and compare the voltage with a first reference voltage corresponding to the first reference value to determine whether the load current exceeds the first reference value.

11.       An electric drill apparatus according to Claim 9, wherein

the current detector is a fixed resistor connected in series with the motor and the main switching element to output a voltage obtained across the resistor correspondingly to the load current, and

the second determination unit is adapted to receive the voltage corresponding to the load current, and compare the voltage with a second reference voltage corresponding to the second reference value to determine whether the load current exceeds the second reference value.

12. An electric drill apparatus according to Claim 5, wherein the control unit comprises:

an on-state self hold unit including a first switching element, for holding the first switching element in an on-state when a starting switch is turned on;

a control signal supply unit for supplying an on-control signal for turning on the main switching element when the first switching element is in the on-state;

a second switching element which turns on when the first determination unit determines that the load current exceeds the first reference value, to prevent the control signal supply means from generating the on-control signal irrespective of the first switching element being in the on-state; and

a unit, responsive to the determination by the first determination unit that the load current is reduced below the first reference value after the load current exceeded the first reference value, for turning off the second switching element at a predetermined time after the determination.

13. An electric drill apparatus according to Claim 5, wherein the main switching element is a triac, and the control unit comprises:

an on-state self hold unit including a first switching transistor, for holding the first switching transistor in an on-state when a starting switch is turned on;

a photodiode for emitting light by being supplied with a current when the first switching transistor is in the on-state;

5 a photo-triac connected between a gate and an anode or a cathode of the triac and optically coupled to the photodiode so that the photo-triac is turned on by light emitted by the photodiode to supply the triac with a gate current;

a second switching transistor, responsive to the determination by the first determination unit that the load current exceeds the first reference value, for bypassing a current of the photodiode to extinguish the photodiode irrespective of the first switching transistor being in the on-state; and

10 a unit, responsive to the determination by the first determination unit that the load current is reduced below the first reference value after the load current exceeded the first reference value, for turning off the second switching transistor at a predetermined time after the determination.